**PEST TECHNOLOGY**
**Pest Control and Pesticides**

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## CONTENTS



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# "PEST TECHNOLOGY" extends Christmas and New Year Greetings to all its readers, wherever they may be . . .

THE WRITER first met Sir Clavering Fison some years ago at a function in Lancashire. Since then much water has flowed under many bridges in all parts of the world; in the interim we have since the development and growth of the British Pesticides' Industry into an Industry in its own right and with a technology all its own.

It was good, therefore, to hear Sir Clavering at the Television Press Conference at Chesterford Park on the 25th November, declare:—

> "*In my review of the year's operations I laid particular stress upon the very considerable investment my Company has in the agricultural spray chemical field. The basic requirements of this industry is the recovery within a reasonable period of the immense investment in brains and capital which are so essential in a new industry and one which is still a pioneering industry if it is to give service to agriculture and indeed remain competitive with the parallel developments which are taking place throughout the world. The next stage after development is the rapid exploitation of the fruits of research.*"

This is stimulating news because it indicates that Sir Clavering's organisation believes in the future of the Industry. However, there are questions one would pose: it would appear to the writer that an adequate return on any large scale cannot come from products sold to this country alone, and one must presume that a good build-up of export trade is envisaged.

Here, however, we are up against some difficulty. Is all well in the export field? Is the Pesticides Industry, so far as export is concerned, functioning as an entity comprised of all those organisations interested in export, large or small? Or is it comprised of individual firms each striving to do its best as a unit but lacking the strength which comes from the umbrella of co-ordinated action?

If we pre-suppose a thriving export trade one would think the logical step is to have as complete a list as possible of statistics about the Industry. But this is by no means easy. In an Industry which has expanded so fast it is perhaps understandable to some extent that there is still not an altogether clear picture of the position. Yet we should have a closer idea than we have of certain facts. What, for instance, is the figure of directly employed personnel in the Pesticides Industry? How many people are employed indirectly? What is the grand total of raw materials employed in, for instance, industrial operation, agricultural spraying, and the domestic scene? Any virile, thrusting, lively Industry—and that is what this Industry is—must have a background of adequate statistical knowledge. One suspects that this is by no means as comprehensive as it might be.

# ★ Treatment of Timber Against Attack by Insects and Fungi in Warm Climates

*by* **D. BOOCOCK,** F.I.W.Sc.

*Technical Director, Standardised Disinfectants Company, Ltd.*

OF THE MAJOR natural enemies of tropical timber, ambrosia beetles attacking logs, powder-post beetles attacking lumber and stain damaging both logs and lumber are the most important pests from the commercial point of view.

## AMBROSIA BEETLES

### Biology

The ambrosia beetles are small beetles, ¼ inch or less in length and black or dark reddish-brown in colour. They are of varied shape but have in common the fact that they spend most of their cryptic lives in tunnels bored in timber and feed on a sticky mould or fungus introduced as spores by the adult beetles and growing on the walls of the tunnels. This mould was first noted by Schmidburger in 1836 and christened " ambrosia." The term ambrosia beetles, now preferred to the term pinhole borers, is used to cover all the members of the family *Platypodidae* and those members of the family *Scolytidae* which attack unseasoned timber.

Very many species of ambrosia beetles attack timber and the commonest genera found, namely *Xyleborus* and *Platypus*, comprise together more than four hundred different species.

Ambrosia beetle adults are flying insects, the flight periods in the tropics being mainly in the early morning aud late afternoon, Certain species, however, appear during the middle of the day, whereas others fly only by night,

The male beetles arrive on logs before the females and select sites for boring. These may be logs with the bark either on or off. On logs with the bark on they frequently select damaged areas where concentrated penetration may occur. Current investigations appear to indicate that fermentation processes, taking place in the sapwood after felling, produce substances attractive to ambrosia beetles. It has been suggested that these substances may be produced or merely unmasked as a result of the bark being removed or damaged.

Approximately 24 hours after the male beetles have started to bore, the females arrive and flit over the surface of the log searching for bore-dust indicating a tunnel inhabited by an industrious male. The male then emerges, copulation takes place and both return to the tunnel, the female leading. The tunnelling is now continued by the female, whilst the male occupies himself by pushing out the borings which appear on the surface of the log as powder or as cylindrical threads hanging from the entrance hole.

Ambrosia beetle infestation normally starts within 24 hours of the log being felled and increases steadily in density over the next 20 weeks.

The tunnel enters the log in a radial direction but, after penetrating for a greater or lesser degree, turns and is continued in a circumferential direction, with or without branching galleries. The tunnel pattern is to a considerable extent characteristic of the boring species and is usually confined to the sapwood in the case of Scolytids, whereas Platypodids frequently bore deeply into heartwood especially if it is relatively moist.

In all species, however, the tunnels have a circular cross-section produced by the beetles rotating as they cut into the wood, and the inside of the tunnel is usually darkly stained due to growth of the ambrosia fungi. The eggs are laid free in the main tunnel or in niches cut in the top and bottom of the tunnels and when the larvae emerge they feed on the fungus. The larvae pass through an unknown number of instars before pupating. When young adults emerge they remain in the tunnel for some time feeding on the ambrosia fungus before leaving by the original entrance hole either to re-attack the same log, or to fly in search of fresh timber. Depending on species, a pair of ambrosia beetles will produce a family of about 20 to 100 offspring.

**Damage**

It is obvious that a single tunnel will appear as a pinhole time and time again when a log is converted to lumber or peeled for veneers. Pinholes cannot be tolerated in decorative veneers and render otherwise suitable wood fit only for use as core stock. Pinholes in lumber are regarded as a standard defect and their presence leads to downgrading. Fungal staining is often associated with pinholes and spreads from the tunnels, sometimes as extensive streaks. This secondary damage is frequently in fact more serious in spoiling the appearance of the timber than the pinholes themselves. Although ambrosia beetles can only live in green timber and die out as the timber is seasoned, this is rarely appreciated by the person buying timber, who regards any hole in wood with ineradicable suspicion. This leads to logs being " dressed " in order to present a clean face to buyers, an obviously costly procedure. It is difficult to assess the extent of the loss caused by ambrosia beetles in economic terms but it is certainly considerable.

**Protection of Logs from Attack and Damage**

Limitation of ambrosia beetle attack and damage is achieved by well-managed methods of log extraction and by the use of properly formulated insecticides.

Because of the speed with which ambrosia beetles go into the attack, logs must be extracted from the forest as quickly as possible and should be kept out of moist, shady situations. Logs which have to be kept in the forest, or stored awaiting conversion or shipping, should be raised off the ground on skids.

The question of whether to remove the bark from logs or not is still to some extent controversial. Logs with the bark on are less severely attacked by pinhole borers at first than barked logs, but the presence of bark may also invite infestation by long-horn beetles. The best course of action is to treat the ends of logs in the forest immediately after felling and cross-cutting, and extract quickly and spray the whole log after barking at a convenient point such as logging park, railhead or storage yard. Chemical treatment should be applied to all logs immediately the bark is removed.

A large number of chemicals have been tested as log protectants. Creosote has given reasonable control in some areas but results have been anomalous. The latest results from West Africa indicate that it gives good protection for several weeks and then quite suddenly fails.

Creosote should never be applied to logs with the bark on as it has been shown that it exerts a chemical action on the bark which rapidly releases substances attractive to ambrosia beetles, and the log then becomes more heavily infested with pinholes than if it had not been treated at all. The same effect with insecticidal emulsions containing anthracene oil as a solvent has been noted and also with solutions of BHC in an aromatic petroleum solvent.

The synthetic chlorinated hydro-carbon insecticides developed over the last 18 years have been tested for protection of logs and of them BHC has proved of outstanding value. DDT, chlordane and toxaphene have not shown promise but aldrin and dieldrin may yet prove useful, although insufficient evidence is yet available for their true potential value to be assessed.

In practice BHC has proved most useful and has been tested in a variety of formulations. The nature of the formulation is most important and it seems that work on formulation of insecticides is more likely to lead to the development of better products for protecting logs than tests of different insecticidal chemicals. Water-dispersible powders give the least satisfactory results as they are readily washed off by rain. To resist washing off by rain, solutions in fuel oil or kerosene have, therefore, been used and more prolonged protection is thereby achieved. The usual practice is to buy a concentrated solution of the insecticide from the manufacturer and then to dilute it on the spot with oil before spraying. Some concentrates contain a fungicide, in addition to BHC, and are used to prevent sapstain as well as pinhole damage.*

BHC emulsions seem to give results nearly as good as those obtained with oil solutions and definitely better than those with water-dispersible powders.

Oil solutions cannot, however, be applied to logs with the bark on, as fuel oil, kerosene and certain aromatic solvents used to prepare concentrates, have the same effect on bark as creosote, rendering the log abnormally attractive to ambrosia beetles. Fuel oil itself appears to be attractive to pinhole borers even when sprayed on barked logs. Other disadvantages of using oil solutions are that oil costs money and tends to discolour white timber.

Consideration of these factors has led to the conclusion that for log protection a water-miscible formulation is

required which after spraying dries to form a water-resistant film. Such a product** is now commercially available, containing BHC as the active ingredient and is diluted 1: 9 before use with water. It can be sprayed on logs with the bark on or off, and does not discolour timber. Good reports have also been received from North Borneo, Malaya and British Honduras. It is hoped to improve this product still further.

Insecticides for log protection should be applied as wet drenching sprays and it is most important to wet the log thoroughly all over, and especially to direct spray on to the undersurfaces. If knapsack sprayers are used they should be of the pressure-retaining type; the Ross type sprayer, so widely used in the tropics for applying mosquito larvicides, is unsuitable for spraying logs. Whenever possible a power sprayer should be used. Chemicals are only as good as the methods used to apply them and managers must insist on thorough application.

The application of concentrated sprays to logs using low-volume air assisted sprayers might repay study and, if successful, would reduce the amount of spray to be taken into the forest.

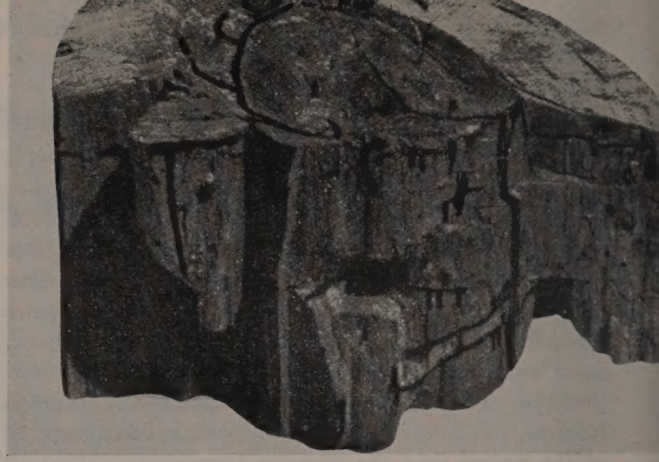
## POWDER-POST BEETLES

### Biology

The term powder-post beetles is used to describe various species of wood borers belonging to the families Lyctidae and Bostrychidae. They are serious pests of seasoned and partly seasoned timber. As their name implies, they reduce wood to a fine powder which when rubbed between finger and thumb has a " floury " feel.

The Bostrychid beetles are of moderate size, varying from $\frac{1}{8}$ to 1 inch in length. On the average they are larger than Lyctids. They are usually dark-brown to black in colour and have a characteristic circular cross-section and antennae ending in a three-jointed club. Both the beetles and the larvae bore into the timber and the bore dust is packed in the tunnels behind them. The tunnels follow the direction of the grain but may have branches. The eggs are laid by the female inside the tunnel.

The Lyctid beetles are small, reddish-brown to black beetles, more elongated and flattened in shape than the Bostrychids and have antennae ending in a two-jointed club. The adult beetles do not bore into the wood. Eggs are laid in the pores of the wood just below the surface by the female. It follows that wood with pores too small to receive the ovipositor of the female are immune. Within a few days, the young larvae hatch from the eggs and start to burrow into the wood. At first the tunnels



*Billet cut to show nature of ambrosia beetle damage.*

follow the direction of the grain but later they may take an irregular course, crossing and re-crossing their own tunnels and those of other larvae. When the larvae are fully grown they move towards the surface of the timber and pupate immediately below the surface. The adult beetle emerges from this pupal chamber and makes its way out of the timber by cutting a small, more or less circular hole. Adults will cut their way, if necessary, when emerging through heartwood, paint, glue and even through lead coverings.

### Damage

The larvae of *Lyctus* beetles need starch for their development and for this reason only timbers with starchy sapwoods are attacked. This, however, includes a large number of temperate and tropical commercial hardwoods—oak, ash, elm, walnut, obeche (wawa), afara, iroko, ramin, meranti, and kempas to name but a few. Ring-porous woods are much more susceptible to powder-post beetle attack than diffuse porous ones. Powder-post beetles do not confine their attack to sawn timber but also attack dimension stock, plywood, manufactured articles, floor blocks, etc., so long as the cells contain starch. The actual physical damage caused may be very severe and if unchecked can literally reduce timber to powder. In addition to direct loss, a firm supplying infested timber can enormously damage its reputation and goodwill. Little in the way of dust is usually seen until exit holes are cut, by which time infestation within the timber will have been active for several months and damage may be considerable. This emphasises the importance of millers and merchants taking routine measures to prevent attack.

### Protection of Lumber

Lumber (sawn timber) can be effectively protected from attack and damage by powder-post beetles by treatment with insecticides. DDT, which was the first of the

modern insecticides to become freely available, was found to give satisfactory protection of timber in temperate climates but failed in the tropics except at uneconomically high concentrations. BHC on the other hand has proved over a period of several years to give first class protection both in temperate and tropical climates.

Both wettable powder and special emulsion formulations of BHC are used for treating lumber. Wettable powders, however, have a number of serious disadvantages. Wettable powders must, because of their very nature, settle after mixing with water and, in dipping baths, the powder settles to the bottom where it forms an ineffective and wasteful sludge. In spraying apparatus, too, the powder settles, unless the equipment is provided with an agitator, and trouble may also occur through nozzle blockages, especially if the powder is not mixed with the necessary care. Such sedimentation is increased in the presence of sodium pentachlorophenate, which is frequently used in conjunction with the insecticide to prevent sapstain. Further, wettable powders leave a visible deposit which is definitely unsightly on red woods.

These disadvantages have been overcome by using a BHC emulsion*** especially formulated for the timber trade. It is easily mixed with water and forms a stable emulsion even in the presence of anti-sapstain fungicides. It spreads evenly over the surface of the timber even when rough cut from the saw and also penetrates below the surface, whereas it is impossible for wettable powders so to do. BHC is exceptionally persistent on timber. Oak blocks in laboratory tests have been protected from damage by *Lyctus brunneus* for over two years, whilst in field tests in West Africa, periods of protection of nine months and over have been recorded.

Dieldrin has shown promise in laboratory tests for protection against *Lyctus* but has not been used to any extent for protection of green timber in practice. It is more expensive than BHC.

Insecticides are best applied to lumber as it comes off the saw by dipping. In large mills the timber passes through a mechanically operated dip placed at the end of the green chain. The timber is immersed for a few seconds only, which is sufficient to give it the necessary protective cover. In small mills, simple hand-operated dipping tanks are used.

When dipping is impracticable, timber may be sprayed. It is, however, difficult to obtain complete coverage of timber in stacks by spraying.

## SAPSTAIN

As soon as a tree is felled it becomes liable to attack by fungi causing decay and staining. In the warm, damp climate of tropical timber producing countries fungi develop rapidly and sapstain or blue-stain soon becomes apparent. Less is heard of dote and decay of tropical hardwoods but this may only be because they develop more slowly and their presence is less obvious in the early stages.

### Biology

Sapstain is caused by fungi. Whereas the most important genus causing staining of softwoods is *Ceratostomella*, stain of tropical hardwoods is most frequently caused by *Diplodia* and *Lasiodiplodia*. Infection of timber is caused by spores which are disseminated by the air and by rain. Dried fragments of mycelium can also be dispersed by air and in mills dust produced by sawing infected logs is probably also of importance. We have already seen that ambrosia beetles carry staining fungi into timber and other beetles and mites may also play a part in transporting spores of staining fungi to timber during seasoning. Whatever the exact role of various transmitting agents, it is certain that *Diplodia* spores are very widely dispersed in tropical timber producing areas and are the cause of other troubles such as brown pod disease of cacao which occurs in Nigeria, Ghana and most other cacao growing countries.

When spores of staining fungi fall on timber they develop and produce hyphae which penetrate the cells of the wood: they do not merely grow on the surface as do species of *Aspergillus* and *Penicillium*, commonly called moulds, which are responsible on occasions for superficial discoloration. The hyphae when first formed are colourless but soon acquire a dark brown colour. The so called staining is caused by refraction of light from these fine, dark brown hyphae threaded through the translucent cell walls: the hyphae are not themselves blue nor do they secrete any sort of blue dye or stain. For this reason it is not possible to bleach blue-stained timber, something we have, incidentally, been asked to do on more than one occasion.

### Damage

Sapstain usually manifests itself as a basically blue stain which varies in colour from a definite blue to bluish-grey or almost black or sometimes a dark, brownish-black. It spreads most rapidly in the sapwood although in tropical timbers it may affect heartwood. It spreads both along and across the grain and may appear as streaks or may completely permeate the whole of the sapwood and in severe cases it looks as though somebody has poured dark blue ink over the timber. When stain

has been introduced by ambrosia beetles it spreads round the holes made by their tunnelling often as streaks. Sometimes if timber has been stored in very damp conditions dark coloured mycelium may grow on the surface but this is not usual and often the staining is internal and may not be seen until the timber is cut. This is due either to rapid drying of the surface before the fungal hypae near the surface have had time to turn a dark colour or in some cases as a result perhaps of fungicidal treatment being applied so late that although the surface is sterilized, hyphae have already penetrated far enough to be out of reach of the chemical and are able to continue growing within the timber.

Stain causes no practical reduction of the strength of timber except so far as toughness or resistance to impact is concerned. Stain is however a very serious and unsightly defect and in the case of light coloured woods such as obeche and ramin serious staining may render timber virtually unsaleable. Stained timber is unsuitable for much joinery and cabinet work and for veneers and facings of plywood. Staining can and does lead to serious financial loss and to waste of valuable timber.

**Prevention of Staining**

The chemicals found most useful for preventing stain are chlorinated phenols and organic mercury salts. The latter have considerable affinity for cellulose and as a result the strength of the solution used for dipping is rapidly depleted. Their cost and relatively poisonous nature also count against them in the tropics. Of the chlorinated phenols, pentachlorophenol in the form of its water soluble salt has proved most generally effective for control of stain and because it is cheap and freely available it is by far the most widely used anti-sapstain chemical. Sodium pentachlorophenate is usually used at a concentration of 1½-2 per cent. in the tropics in conjunction with an insecticide when powder-post beetles are also likely to cause trouble. Borax should be added to the dip as a buffer.

Finally it is most important that chemical control measures be used in conjunction with sound practices of extraction and seasoning.

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★ A paper "Treatment of Timber Against Attack by Insects and Fungi in Warm Climates" by Mr. D. Boocock, presented at the Annual Convention at Cambridge this year of the British Wood Preserving Association.

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*PROTOSTAN
* *HEXASTAN LP
* **LYXASTAN

*NOTE. PROTOSTAN, HEXASTAN and LYXASTAN are registered trade names of the Standardised Disinfectants Company.*

# introducing . . .

# the KOLIBRIE

*The Kolibrie on the Helicar trailer.*

**Our reporter went to see the demonstration at Ipswich on 10th November of this new universal twin-engined ramjet helicopter designed for low-spraying of crops.**

PRODUCTIVITY HAS REACHED the crop spraying section of the pesticides industry in no uncertain manner: at a rate of 75 acres per hour, a new device, demonstrated in Britain for the first time on 10th November showed that the operation can be quick and efficient. Unit operating is the Kolibrie Universal Twin-engined Ramjet Helicopter. It was in October of 1955 that the Nederlandse Helicopter Industrie (NHI) of Rotterdam, first produced this multi-purpose machine, known as the Humming Bird. Research occupied 15 years.

The Kolibrie differs from other helicopters in the following salient points: it has been designed to reduce the cost per flying hour; simple in construction, using tip-mounted ramjets with no moving parts; complicated piston engines are eliminated, as are clutches and transmission. Low initial price and low cost of maintenance are the rewards.

The rotor is self-adjusting and the rotor, two-bladed, gives high inertia.

Another advantage is a low empty weight ratio to a relatively high useful load.

In agriculture, it is anticipated the Kolibrie will find its greatest outlet in spraying, dusting and sowing and fogging.

The spraying gear with booms is collapsible for road transport. It consists of 1 to 4 tanks for fuel and/or spraying fluid, dusting equipment, seed container and fogging equipment.

Outstanding flying characteristics of the Kolibri and low cost of the operation and maintenance makes it specially suitable. Because no dangerous altitudes exist it is of special importance for agricultural tasks which involve particularly low flying. Moreover, its ability to execute extremely steep turns avoids loss of time in spraying operations.

The helicopter has been designed with crop spraying as one of its main uses. The spray boom of stainless steel, braced with guy wires, is flexible and collapsible; so that, if struck against the ground or a tree, the risk of damage to the helicopter is greatly reduced. The boom extends beyond the rotors. The pilot therefore need not worry when flying near trees, pylons or buildings because the flexible boom will strike the obstruction before the rotors.

The nozzles are of a swirl type, with numbered discs, which give droplet sizes from 80 microns to 200 microns. They are staggered along the length of the boom in order to give the most efficient coverage possible. The spray is held in containers on each side of the helicopter and

*Equipped with spraying boom for agricultural spraying at 75 acres per hour, the twin-engined ramjet Kolibrie helicopter is seen in action. Note the low height possible which keeps drift to a minimum. The Spray-boom is 55 feet wide.*

*A Kolibrie landing on its "Helicar" trailer. It was demonstrated by European Helicopters Ltd., at Ipswich Airport on 10th November.*

pumped through wide diameter plastic pipes by means of a stationary engine mounted on the port side, which in turn drives a rotary type pump. This provides adequate recirculation of the chemical.

The engine is connected to the rotor blade tip by two flush bolts. Changing of an engine is really a matter of minutes, also because fuel and electric connections are automatic.

The Kolibrie's ramjets consist of a streamlined shell containing fuel jets, baffles and low-tension igniter.

Ramjets have a higher fuel consumption than other engines but in this case compensation is gained by the burning of cheap household-grade kerosene and by their extremely low dry weight.

A novel feature of the Kolibrie is the technique of landing on a special trailer called a Helicar, and from this mobile base it makes all its spraying sorties. Raised on the trailer, free of mud or uneven ground, it can be safely refuelled by the ground crew without danger from the rotors. The use of the Helicar for transporting the Kolibrie by road from farm to farm, reduces flying time and strain on the pilot, by easing his difficulties in finding the farm and a suitable landing site.

The use of the Helicar trailer means there is a mobile platform for take-offs and landings and in agricultural operations the Helicar enables the pilot to operate from the ground being worked.

The chief advantages of the Kolibrie are:

1. Lightness of controls and all-round stability.
2. Manoeuvrability.
3. Safe flight in case of tail rotor failure.
4. Low maintenance costs and quick repairs.
5. High rate of spraying per hour.

The demonstration was arranged by European Helicopters Limited, which has the sole U.K. rights of import and distribution of the Kolibrie helicopter.

An official of the Company said that his firm were convinced that the Kolibrie had "a great future in agricultural application, such as crop spraying."

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Mice gnawed holes in the *organ pipes* of St. Mary's Church, Homersfield, Norfolk and the repairs cost £40.

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A wide range of packaging machines for the production of insect proof packaging media is being manufactured by Soag Machinery Company of Juxon Street, Lambeth, London, S.E.11, it is announced.

# Preservation of Mist Eliminators in Cooling Towers

A FILM SHOWN on 29th October at the London Building Centre illustrated an interesting new process by which the natural decay of mist eliminator timbers is considerably retarded, thus achieving significant ecomonies in the operation of cooling systems in power stations and similar plants. The new technique has been evolved by Richardson & Starling Limited, timber decay specialists, and was first applied by the firm to cooling towers at Croydon "B" Generating Station during April and May this year.

Timber mist eliminators, which are designed to reduce passage of spray or mist up and out of the towers, are inherently subject to attack by various species of wood-rotting fungi which flourish in the constantly damp and humid conditions.

The new process takes advantage of the action of soft rot microfungi, which render the outer regions of affected wood extremely absorbent and permeable and thus provide reservoirs for preservative chemicals. In practice, it is generally found that mist eliminators become suitable for treatment when they have been in service for at least two years, since at this stage the necessary degree of incipient rot has usually developed.

Treatment is commenced some hours after shut-down of the tower, as soon as the moisture content of the timbers is found to have fallen to a suitable level. The baffles are first of all sprayed with a pre-determined quantity of a water-soluble preservative such as copper sulphate, which is left to diffuse inward and then fixed in the wood by a second spray application of salts of chromium.

In spraying, considerable care is required to avoid over-saturation of the timbers, since any dripping of chemicals on to the lower parts of the towers might cause contamination of pond water with consequent damage to the cooling system machinery.

*(above)*
*Applying the first stage of the double-diffusion treatment to mist-eliminator timbers, using controlled technique.*

*(below)*
*Softrot (Ascomycete) decay in a mist-eliminator supporting post and plate.*

# FISONS

## *first with modern medium*

WHAT is believed to have been the first inter-city television press conference in the world was inaugurated by Fisons Pest Control Limited on 25th November.

Apart from communicating with the national provincial press it was desired on this occasion to reach the scientist, the adviser, the distributor and the customer.

On the day in question, Chesterford Park (near Cambridge) was linked with London, Bristol, Manchester, Edinburgh, and Lincoln.

The company previously has pioneered modern methods of communication such as sound links as far afield as Canada and Italy.

" But because demonstrations play so vital a part in our specialist field, we felt that in this presentation we must have vision allied to sound," said an official.

News was beamed via land line and micro wave to the five centres mentioned, this system makes it possible for the leading executives of any company to speak personally and simultaneously at one meeting to their own representatives, the distributive trade, the press and the customer.

The audience addressed on the 25th November totalled around one thousand. Commented a representative of Fisons Pest Control:-

" Frankly, we consider this only an indication of what will be possible in the future. Despite the difficult passage through which the Free Trade Area is presently passing, most of us in industry consider that it will soon become a trading fact of the greatest importance to the manufacturers of this country. We shall need then to confer rapidly with colleagues throughout the whole Common Market area and our conference tomorrow will be the pattern for the international teleconference which we consider an inescapable part of lively communication in an intensely competitive market which will number over 250,000,000 souls."

The technical arrangements were in the hands of Pye Ltd., of Cambridge and the arrangements went off without a hitch.

Sir Clavering Fison (Chairman, Fisons Limited) gave an introductory address, followed by Dr. R. K. Pfeiffer (Head of Botanical Section, Chesterford Park Research Station) who presented a Technical Survey of Fisons 18-15. Mr. A. C. Abel, Technical Adviser, Chesterford Park Research Station, spoke on " Choosing the correct weedkiller," and " Commercial Appreciation of Fisons 18-15." was given by Mr. H. G. Rope (Sales Director, Fisons Limited).

This event occurred as " P.T." was printing but we shall refer to it more fully in our next issue.

# BRITISH WEED CONTROL CONFERENCE

SEVENTEEN OVERSEAS' COUNTRIES were represented when the Fourth British Weed Control Conference opened at Brighton on the 4th November. Over 400 representatives attended. Professor H. G. Sanders, President of the British Weed Control Council, in his opening address, referred to developments in weed control as " tremendous." Weed control had changed the face of the countryside.

Opening lecture was by Dr. E. K. Woodford (ARC Unit of Experimental Agronomy, Oxford). Surveying international progress in chemical weed control, Dr. Woodford observed that progress in chemical weed control was dependent on the activities of the chemical industry just as much as it was on the work of the official research organisation, and that collaboration between Industry and the State was of paramount importance.

" The nature of this collaboration in different parts of the world varies with the government of the country and with its agricultural chemical manufacturing capacity, if any. On the one hand we have the U.S.S.R. where ' collaboration ' is complete and Mr. Kruskchev has laid down that more time will be devoted to research on herbicides and that the 1957 production of 600 tons of 2,4-D per year shall be increased to the calculated requirements of 10,000 tons. On the other hand there are the democratic countries, ranging from those that produce large amounts of herbicide, such as our own, to those that have to import all their requirements. Where large chemical industries exist, the problems of collaboration assume the greatest importance. In countries that import their herbicides the State has the opportunity of assuming most of the responsibility for developing new herbicides and for advising the growers about their use. This is the situation in the Scandinavian countries, but in other parts of the world, where agriculture is not so highly developed, such as in British Africa, the State may delegate many of these responsibilities to commercial interests.

Comparisons of the relationships that exist between the State and Industry in the U.S.A. and the U.K. are interesting. In the U.S.A. Industry expects the State to carry out most of the field evaluation of its new chemicals and in consequence to be in a position to give advice concerning their use. In return the State assumes the right to lay down strict laws relating to the application of herbicides, and expects Industry to carry out very detailed research on residues and toxicology. Such provisions have been incorporated into

## "This lack of official statistics . . . ."

The Miller Bill (Public Law 518 of the 83rd Congress) and this is probably the most important development in herbicides that has taken place in the U.S.A. during the last few years. Some would not agree that it was progress. In Great Britain, in contrast, Industry sets up its own field research organisations and does most of its own development work on new products. In return, the State lays down the minimum of rules and regulations concerning the sale and use of herbicides, runs a voluntary approvals scheme for proprietary products and allows Industry to sell anything so long as it complies with the Poisonous Substances Act."

The progress that resulted from freedom for Industry must be weighed against the restrictions which were required for the protection of the public.

" I learnt most of my agriculture in Canada" went on Dr. Woodford, " a country that has benefited both from her British ancestry and her contacts with the U.S.A. Her ' Pest Control Products Act ' contains sense and moderation. One day, I think, we too will have to require that the quantity and nature of the active ingredients in every proprietary weedkiller will have to be declared before it is offered for sale to the public. Similarly it will be necessary to tighten up on restrictions concerning some of the methods of applying herbicides. It has been found necessary in other countries to restrict or ban the application of 2,4-D and similar herbicides from the air and to insist that aerial spraying operators obtain permission from, or notify local authorities before they are allowed to operate. The British Weed Control Council has already issued warnings concerning the application of growth regulating herbicides from the air and, if I judge the situation aright, both aerial spraying contractors and chemical manufacturers are hoping for some lead from the State in these matters which would protect them, and the public, from the haphazard use of these chemicals by the over-adventurous.

" The rapid progress that has taken place in chemical weed control during the last ten years has been due in no small part to the cordial co-operation that has existed between the official and the commercial people engaged in the practical application of this new technology. Anything that tends to detract from this parternship would be undesirable. The British Weed Control Council is unique in British agriculture and can play an important part in helping to ensure that a happy balance is maintained between the sometimes divergent interests of the State and commercial enterprise."

Discussing the assessment of progress, Dr. Woodford said that ultimately the real criterion of progress must be measured in terms of the increased efficiency of crop production made possible by improved techniques of weed control. Dr. Woodford confined his observations to progress as measured by:--

(a) The quantities of herbicides used.

(b) The nature and extent of teaching and advisory work on chemical weed control.

(c) The research and development work accomplished.

" This lack of official statistics, on either the sale or use of herbicides, is particularly apparent in the U.K. Detailed surveys of fertiliser usage are carried out annually and in 1954, '55 and '56 a few questions on herbicides were included in this survey, but nothing has been done since," said Dr. Woodford.

" Now that chemicals have become so important on the farm it would seem very necessary that we should know who is using them, how much is being used and how correctly. This information is necessary not only for the advisory officer but also for those who are concerned with agricultural policy and with the direction of agricultural research. Nowadays when so much information is collected about the crops that farmers grow and the types of machinery they possess, surely it would not be very difficult to ascertain if and where herbicides are being applied?"

In many countries, said Dr. Woodford, there had been an increase in the number of people engaged in the advisory and regulatory aspects of weed control.

In this country chemical weed control was often a very small item on the curriculum of agricultural colleges and university departments of agriculture.

" I particularly noticed this shortcoming in our agricultural education on my recent visit to East and Central Africa where time and again I met agricultural graduates from British colleges and universities who had no idea of the principles underlying the different types of herbicidal action and not much idea of how the different

**" Educating the adviser . . . . comparatively easy compared with the user of these chemicals."**

herbicides should be used. Unless agronomists responsible for the testing of these new herbicides have some basic training in the mode of action of phytotoxic chemicals, unless they understand, in a general way, how the different herbicides work, how they enter plants, move within plants, and persist both in plant and soil they will never be able to appreciate the ways in which climatic conditions, soil types and formulations are likely to influence their results and it is unlikely that they will make a good job of evaluating the potentialities of the new chemicals.

" There is a need for more teaching of both the theory and practice of modern methods of chemical weed control. A lot is said and written about increasing technological training, but technology is invariably limited to the applied aspects of the physical sciences and applied biology is forgotten. Surely there is also a need for expansion in the teaching of applied biology and in particular the biology of phytotoxic chemicals. There is, as far as I am aware, no college in this country where citizens can take a full time course in the technology of chemical weed control. Nevertheless, Colombo Plan Trainees coming from abroad and desiring to learn about the control of pests and weeds are given special courses, not at a state college, but at a school run by an industrial firm. I haye always thought it rather odd that the State should delegate such responsibilities and that similar courses are not available for our own trainees.

" Educating the advisor and specialist in weed control must be comparatively easy compared with educating the user of these chemicals. Progress means more and more chemicals and as the number of chemicals increases so each tends to become more specific and limited in its application, for safety is dependent on specificity and specificity is inversely proportional to demand. Eventually the stage is reached when the average farmer and grower is no longer able to decide for himself which is the correct herbicide for his requirements. In the U.K. we have already reached this stage and, in this respect, are definitely leading the world. Our intensive mechanised agriculture, combined with the ingenuity of our chemists, has resulted in the position that the cereal grower now has ten different chemical types and more than 80 approved herbicides from which to choose.

" At present the farmer relies mainly on the advice of technical representatives of manufacturing firms, but this is not alwasy sufficient; he often needs advice from impartial consultants. This could be given by the N.A.A.S., independent consultants, or the specialist advisory services of agricultural merchants. It would be right, I think, for the State to assume more responsibility in this matter, but this cannot be done unless the advisory service has its own specialists and there are stricter laws concerning the declaration of active ingredients in proprietary products. The responsibility for giving impartial advice seems to be devolving more and more on the merchant who dispenses these materials, but whether he can afford the personal field inspection, often so essential for correct judgement, seems doubtful. It has been suggested the swing will be back again to the specialist contractor, but this seems unlikely."

Commenting on the growing number of weed control conferences held, in different parts of the world, Dr. Woodford said that the awakening of interest in herbicides in Europe, Asia and Africa was significant. Research on new chemicals had increased, particularly in Germany and Switzerland and there was growing competition in Industry, while in most sub-tropical and tropical countries the emphasis was on the field evaluation of existing herbicides and the problems of weed infestations that built up with alarming rapidity. The contrast between the type of progress that was required in undeveloped countries, such as Africa, and that required in countries where crop production was so much more intensive and becoming ever more dependent on mechanisation, was emphasised. In all countries, however, progress is dependent first on discovery of suitable chemicals, Dr. Woodford said.

**New Chemicals**

During the two years since their last conference many new herbicides have been discovered and tested. Some were already on sale to the public.

" Perhaps the most outstanding group of chemicals that have been tested during this period are the substituted triazines. The herbicidal properties of a few of these chemicals were given by Gysin in a paper at our last conference, but other derivatives have since shown many different types of activity, ranging from

**". . . . the widespread acceptance of mecoprop . . . ."**

an immediate contact effect to a slow systemic action, as well as many types of selectivity.

" Next in order of interest I would place the discovery of the herbicidal properties of 2:2-ethylene dipyridylium dibromide. A completely new type of phytotoxic molecule, with a very rapid action that seems to be dependent on a mechanism of transport that is operative only in the above ground parts of the plant.

" Another important development in new herbicides has been the introduction of chemicals that are partly volatile and can therefore be used for the control of weed seeds after they imbibe water and before they have fully germinated. Herbicides in this class are, dithio carbamates such as Vapam (sodium methyl dithiocarbamate) and the thiadiazine, Mylone (3,5-dimethyltetrahydro-1,3,5,2H thiadiazine-2-thione), as well as 1,2,4,5-tetrachlorobenzene.

" In addition we have the thiol carbamate EPTC (ethyl-N,N-di-n-propylthiolcarbamate) and new variations on old themes such as fluoro substituted phenoxyacetic acids phenoxythio acetic acids, 2,3- and 2,3,6-phenylacetic acids and variously substituted benzoic acids.

" In the U.K. the most important progress has been concerned with the widespread acceptance of mecoprop (CMPP) for the control of cleavers, chickweed and other weeds of cereals. The properties of this chemical were made public for the first time at our last weed control conference. More recently a mixture of 2,3,6-trichlorobenzoic acid and MCPA has been marketed for the control of weeds in cereals resistant to 2,4-D and MCPA. These are both big steps forward in cereal weed control. In addition dalapon has become more generally available and its place as a grass killer both in temperate and tropical countries has become established.

**Mixtures of Herbicides**

" Progress, as I have mentioned, is bound to be associated with the introduction of herbicides possessing increased specificity. In order to make the best use of these new chemicals and avoid unnecessary application costs it is often advantageous to apply them as mixtures. Mixing can be undertaken by the farmer or the grower, for instance the mixture of dalapon with 2,4-D to control a combined infestation of grass and broad leaved weeds. Sometimes it is preferable for the mixtures to be made up by the manufacturer because the weed problems that the mixtures are designed to control are fairly common. For example, MCPB is mixed with a small quantity of MCPA for application to undersown cereals when charlock and other weeds that are tolerant to MCPB and susceptible to MCPA are present.

" There may also be special advantages to using more than one herbicide and applying them at different times. For instance, the best way of controlling perennial thistle (*Cirsium arvense*) that is infesting a cereal crop may be to spray with MCPA or 2,4-D when the crop has tillered and then to retreat the thistle shoots in the stubble with amino triazole. The advantage of such a double treatment is that the amino triazole, because of its effect on chlorophyll, causes the thistle to die by using up its last reserves of carbohydrate, which have been severely depleted by the first application of an auxin herbicide which is safe to use in the cereal.

" Perhaps the most important reason for mixing herbicides is in order to obtain a beneficial interaction, or synergism, between the ingredients of the mix. Synergism has been claimed for several proprietary herbicidal mixtures, but there are few published data giving detailed assessments and one suspects that much of the industrial work on synergism is carried out with the intention of satisfying the Patenting authorities. Unfortunately, these gentlemen, judging from some of the data accepted in Patent specifications, seem to have little idea of the precise meaning of synergism. In consequence much of the work on this very interesting and important aspect of herbicides is misdirected and visible progress is slow.

**Formulation and Application Methods**

" The formulation of herbicidal chemicals can play a very big part in determining their toxic and selectively toxic effects. Progress in this sphere has been pioneered by the U.S.A. and in particular by Dr. Beatty and his Company. Developments during the last few years have been many; perhaps the most important of which are granulated formulations, low volatile ester and acid formulations, and invert emulsions.

## "The aeroplane and helicopter are becoming more widely used . . . ."

"Application methods have changed little. The aeroplane and helicopter are becoming more widely used in many European countries and we now have the European Aviation Centre at the Hague. The technique of logarithmic spraying has been tested extensively and has been found to be an invaluable tool for the preliminary field evaluation of new herbicides.

### New Techniques

"In the past most new herbicides have been developed for application by conventional machinery, to crops that are grown in the normal way. In other words, they have been used as pesticides to remove the pest when it becomes troublesome, in the same way as insecticides and fungicides are employed to control infestations of insects and fungi.

"Nowadays farmers and growers, as well as agronomists and horticulturalists are beginning to realise the difference between a herbicide and a pesticide. Weeds, because they are always present and can be removed by cultivation, are a major factor in crop production. It is not surprising, therefore, that many of the traditional methods of crop husbandry are based on weed control. Herbicides can, in consequence, have a profound effect on cropping methods, for they give the farmer and the grower a freedom of cropping that has never before been possible."

Referring to the advantages of herbicides for killing grass sward prior to reseeding, Dr. Woodford said this work was just the beginning of this wider approach to the use of herbicides.

"Chemicals will in future be employed to replace many cultivation operations that are now considered essential, and completely new methods of crop production will be developed. Such progress, which is concerned with the incorporation of either old or new herbicides into cropping systems in order to develop new cultural techniques, is a task much more for the State than Industry and is an aspect of research with which we in the A.R.C. and the N.A.A.S. are going to be particularly concerned. A really good selective pre-emergence weedkiller for sugarbeet would revolutionize the mechanization of this crop. A selective weedkiller for *Agrostis* spp. and *Festuca* spp., the main weeds of grassland, might completely change the existing systems of grassland management. The laborious cultivations sometimes considered necessary for the preparation of a seedbed may be replaceable, wholly or partly by herbicides.

"In the past crop production has been based on the assumption that we had to live with the weeds, in the same way as in the past we thought we had to live with many diseases that have now been eliminated. In time, weeds too will be eliminated in many crops and as we approach this ideal for one crop after another all who are concerned with crop production will have to devote more and more of their time to re-thinking their subject in terms of weed-free growing conditions. There are indications that this is happening already. The remarkable selectivity of a herbicide such as simazin has made the writing on the wall much clearer. If simazin can keep maize and beans weed-free, why shouldn't other chemicals be found that would keep sugarbeet, blackcurrants, raspberries and many other crops weed-free? There is, as far as I can see, no reason why these shouldn't be found, and if the screening of new chemicals proceeds at the rate it has during the last few years, it should not be too long before some are available.

"So far," concluded Dr. Woodford, "our technology seems to have gained comparatively little from basic research. Much of the time of research workers in the laboratories has been devoted to trying to explain why the practical man obtains results and few principles for his future guidance have emeergd. But it is worth while remembering the apt analogy that money spent on applied research is comparable to investment in National Savings Certificates while money invested in basic research is like purchasing Premium Bonds. Any day a handsome dividend may emerge from basic research. In the meantime, we should make sure that those of us who are concerned with the applied side should make full use of the increasing knowledge that is accumulating on the mode of action of different herbicides, the factors controlling their entry, movement and persistence in both plant and soil, as well as the nature of their biochemical effects at the site of physiological action within the plant. For it is when there is real co-operation between the basic and the applied worker that most progress is made. This co-operation must, however, be a two way system. In this country it is too often assumed that progress is dependent on a flow of ideas from the laboratory to the field. I have found that the backroom fundamentalists can often learn as much from the agronomist as the agronomist can from the fundamentalist."

# WEED CONTROL CONFERENCE—Abstracts

**" . . . . Still a considerable acreage of permanent pasture in the U.K. . . . . unlikely to be ploughed in the near future . . . . "**

## 2,4-DB AND ITS BUTYL ESTER: RESIDUE LEVELS IN SEEDLING LUCERNE.

*By* H. A. Glastonbury, Margaret D. Stevenson and R. W. E. Ball.
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Data on the persistence of herbicides are required for crops grown for human or animal consumption and any method of analysis should preferably be sensitive to at least 1 p.p.m.

It is imperative that analytical methods for 2,4-DB and its ester should be specific because the acid, phenol and free halogen content of plants is so high and variable as to interfere with methods based on ultraviolet spectroscopy, polarography, the determination of the corresponding phenols after hydrolysis with HBr or the determination of chlorine after reduction of the compounds with sodium or with Raney nickel. Infra-red spectroscopy is the only specific method discovered to date and the greatest sensitivity is obtained using the KBr pressed disc technique.[1]

The use of organic solvents proved unreliable for the extraction of these and other organic compounds from plant material. Therefore, 2,4-DB was extracted with aqueous solution and the ester recovered by steam distillation.

An isotope dilution technique[2] using $C^{14}$-labelled compounds was used to correct for the large and variable losses which occur during the purification of plant extracts for infra-red analysis.

Throughout this work the aims have been to establish curves for the persistence of the various compounds under a variety of conditions and to attempt to determine any relation between persistence and variable factors such as spray rate, weather conditions, or growth stage of the plants at the time of spraying.

Corrections for growth dilution have been applied to all results.

**Conclusions**

1. Satisfactory methods sensitive to 1 p.p.m. have been developed for the estimation of residues of 2,4-DB and its butyl ester in lucerne.
2. In a series of field experiments the persistence of 2,4-DB applied as the sodium salt to seedling lucerne at spray rates up to 3 lbs. per acre was from 7 to 28 days and dependent upon initial dose rate and growing conditions. When the very high spray rate of 4 lbs. per acre was used the limit of detection was not reached until 42 days after spraying.
3. In field experiments on the persistence of the butyl ester of 2,4-DB in seedling lucerne the ester was rapidly broken down to 2,4-DB in the plant.
4. The persistence of 2,4-DB in ester treated plants was longer than in plants treated under the same conditions with the equivalent rate of the sodium salt.
5. The experiments have demonstrated that the rates of disappearance of 2,4-DB, its ester and 2,4-DB resulting from the breakdown of the ester depend on a variety of factors and further, carefully controlled laboratory experiments would be necessary to evaluate the relative importance of these.

REFERENCES

[1] Stimson, M. M., and O'Donnell, K. J., *J.A.C.S*, 1952, 74 1805.
[2] Calvin, M. et al., " Isotopic Carbon," 1949 (New York: Wiley & Sons).

## THE CONTROL OF WEEDS IN PERMANENT PASTURE BY MCPA AND THE SUBSEQUENT EFFECT ON HERBAGE PRODUCTIVITY.

**(An Interim Report).**

*By* H. K. Baker, *The Grassland Research Institute, Hurley, Berkshire* and S. A. Evans, *N.A.A.S. Liaison Officer, A.R.C. Unit of Experimental Agronomy, Oxford.*

The effect of controlling weeds in a permanent pasture, by spraying with MCPA upon the production of the different sward constituents was investigated for two seasons. MCPA was effective in suppressing *Ranunculus repens*, *R. acris*, and various Compositae species. The clover content was slightly reduced by spraying but this reduction was temporary.

Spraying alone did not markedly affect the total herbage production of the sward but the application of nitrogen had a much greater effect. Nitrogen alone increased the total herbage yield and was only slightly more effective where weed species had been controlled by spraying: yield of grass and clover however, was increased slightly by spraying, much more by nitrogen and most by both spraying and applying nitrogen.

There is still a considerable acreage of permanent pasture in the United Kingdom which, for a variety of reasons, is unlikely to be ploughed in the near future. Although a small proportion of this is of a high feeding value the majority is dominated by inferior grasses and frequently infested with dicotyledonous weeds. Many of these weeds can now be eradicated by chemical treatments but little work has been done, under practical conditions, to determine the effect of removing the dominant weeds on the long-term productivity of permanent pastures.

A report from New Zealand indicated that when the nutritive value of pasture is related to grass/clover balance, as in lamb fattening, the damage caused to clovers by the use of MCPA and 2,4-D, although temporary, can cause a serious long term productive loss. There appears to be no published work relating to the British Isles.

*Ranunculus repens* and *R. acris* are two weeds which can be controlled well by MCPA and the object of the experiment was to investigate the long-term effects of spraying a permanent pasture infested with these species. Total herbage yield and botanical composition have been studied for two seasons after spraying both in the presence and in the absence of applied fertiliser nitrogen.

It is planned to continue the present measurements for a further one or two seasons and it is hoped that this will be the first of a series of trials in which the long-term effects of controlling various weeds under a wide range of practical conditions will be investigated.

**" Lucerne is known to be less tolerant of growth regulator herbicides . . . . "**

## 2,4-DB AND MCPB IN LUCERNE. Part I. The effect of 2,4-DB and MCPB on the development of the lucerne plant.

*By* R. W. E. Ball and Margery Soundy, *Agricultural and Horticultural Research Station, May and Baker Ltd., Ongar.*

Lucerne is known to be less tolerant of growth regulator herbicides than either red or white clovers and its importance as a crop in Europe and the American continent underlines the necessity of finding a weed killer which it will tolerate. The work leading to the introduction of MCPB as a weed killer in clover crops suggested that 2,4-DB might offer some advantage over MCPB in lucerne tolerance and the greenhouse experiments were designed to compare the two compounds for toxicity to lucerne and to provide information for later field experiments.

A comparison of plant reaction at different stages of growth should ideally be treated as one experiment so that environmental differences during the period of recovery are reduced to a minimum. In this work we were compelled by circumstances to treat each growth stage as an individual experiment. In the first series, however, the four experiments were sprayed during a period of one month and differences in light intensity and duration were almost zero. The second series, concerned with an additional comparison between sodium and amine salt formulations, was spread over a period of four months. Throughout each series a five-week period of recovery was allowed between treatment and dry weight estimations and conclusions relating to susceptibility and growth stage are more valid in series 1.

The results obtained for both mortality and dry weight reduction show that the tolerance of lucerne (var.: Provence) towards MCPA reaches a maximum at the 1st trifoliate leaf stage. Results for MCPB and 2,4-DB follow a similar pattern at a higher tolerance level. It is clear that in terms of dry weight reduction 2,4-DB is at least 2-3 times less toxic than MCPB when sprayed at any growth stage up to the 2nd trifoliate leaf. In terms of kill the differences are greater and approach nearer to a factor of five.

The second series of experiments should be considered solely as a comparison between the sodium and amine salts at each growth stage. Results for Na and amine salts of MCPA are exactly similar at the cotyledon and primary leaf stages. With 2,4-DB there are indications that the amine salt is more toxic at the primary and second trifoliate leaf stages.

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## An EXAMPLE of the RELATION between PALATABILITY of PASTURES and SELECTIVE BUTTERCUP CONTROL.

*By* J. D. Phillips and R. K. Pfeiffer
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*(Fisons Pest Control Ltd.)*

It is a well known fact that cattle and horses try to avoid buttercup infested parts of a pasture if they can find a piece of pasture free of this weed. The degree by which this preference is correlated to the density of buttercup infestation has never been closely studied. It was pure coincidence that a weed control experiment with the logarithmic sprayer which was laid out to give information on the relative degree of buttercup control after spraying MCPA, 2,4-D, MCPB and 2,4-DB enabled us to obtain fairly accurate information on the correlation between buttercup control and selective grazing.

Although well aware of some limitations of the results obtained, it was thought worth while to present the results, as a contribution to a subject on which published evidence is negligible.

**Results**

The results, both degree of buttercup control and degree of grazing are shown in the following tables. The correlation coefficient was then calculated on all figures disregarding the individual chemicals, showing a highly significant correlation between the two factors. Details of the statistical analysis are presented below the table.

MCPA

| Dosage oz. per acre | % grazing | % buttercups controlled |
|---|---|---|
| 32-22 | 91.7 | 100.0 |
| 22-16 | 89.6 | 100.0 |
| 16-11 | 91.9 | 100.0 |
| 11-8 | 83.7 | 98.5 |
| 8-6 | 63.1 | 89.4 |
| 6-4 | 69.6 | 63.3 |

2,4-D

| % grazing | % Buttercups controlled |
|---|---|
| 80.2 | 98.5 |
| 87.1 | 89.3 |
| 59.8 | 67.9 |
| 55.6 | 68.0 |
| 38.7 | 5.3 |
| 49.4 | 28.2 |

MCPB

| Dosage oz. per acre | % grazing | % Buttercups controlled |
|---|---|---|
| 64-45 | 91.1 | 93.9 |
| 45-32 | 93.5 | 97.0 |
| 32-22 | 85.1 | 93.9 |
| 22-16 | 50.1 | 83.2 |
| 16-11 | 36.3 | 83.2 |
| 11-8 | 23.2 | 26.7 |

2,4-DB

| % grazing | % Buttercups controlled |
|---|---|
| 82.0 | 95.4 |
| 90.7 | 100.0 |
| 83.8 | 92.4 |
| 75.9 | 93.9 |
| 44.8 | 78.6 |
| 9.4 | 46.5 |

Correlation coefficient, calculated on all figures disregarding chemicals = 5.747.
Significance of correlation coefficient higher than 99.99%.

**" . . . . farmers are either not worried by the presence of weeds . . . . "**

## THE EFFECT OF MCPA, MCPB AND 2,4-DB ON THE PRODUCTIVITY AND BOTANICAL COMPOSITION OF PERMANENT PASTURE.

*By* R. S. L. Jeater,
*Plant Protection Ltd., Fernhurst Research Station.*

**Synopsis**

A two year project was started in 1956. Four trials were laid down on permanent pasture, two had *Ranunculus repens* as the main weed and two *Cirsium arvense*. The botanical composition was assessed by eye on a percentage ground cover basis. The productivity was measured by taking two cuts each year and recording the green weight. A sub-sample from each plot was analysed for dry matter determination. A crude protein analysis was carried out on the samples from the second cuts in both years. At both cuts in the second year a sub-sample of the green material was separated into grass, clover and weeds to determine the proportion of each.

All the chemicals gave a satisfactory control of weeds and did not materially affect the total amount of green herbage produced, thus when weeds had been removed there was a corresponding increase in the amount of grass and clover.

The method of assessing productivity in these trials was not entirely satisfactory as the technique used had a very deleterious effect on the clovers.

**Introduction**

The introduction of selective weedkillers such as MCPA and 2,4-D was followed by a rapid increase in their usage in cereals, but there was not a parallel expansion in grassland. This was thought to be due to the damaging effect the chemicals had on clover, but if this was in fact the case, then there should have been an expansion in the use of weedkillers in grassland with the introduction of the butyric compounds which did not materially affect clovers, but no such expansion has yet materialised. Admittedly the weed control spectrum of these butyric compounds was not as great as the acetics, but they did give an adequate control of some of the more important weeds of grassland such as buttercups and thistles.

It would appear, therefore, that farmers are either not worried by the presence of weeds in their pastures or they are not convinced that the removal of weed competition would result in an increase in the productivity of the pasture.

This question of the effect of spraying on pasture productivity has been under consideration for some time, but so far no technique has been evolved which will adequately give a measure of the productivity of such pasture. Many factors contribute to this. First, the actual crop is not the end product, it is merely an intermediate in the production of such commodities as milk and beef. Secondly, pasture is a complex ecological unit in unstable equilibrium. This equilibrium is modified not only by the maximum and minimum growth and development stages in the plants making up that community but also by the management it receives in the form of grazing and cutting. Any trial designed to investigate this problem of pasture productivity as affected by herbicides must, therefore, be experimental in trial technique. As there are many variables involved, it follows that in any preliminary trial it is advisable to keep them down to a minimum. In this respect the use of a mowing machine rather than the grazing animal for removal of the herbage is more uniform even though it is not exactly related to practice.

When considering the time to take cuts in productivity work on weedy pastures, two factors have to be taken into account; the effect on the weeds and the effect on the grass and clover. If cutting is carried out at frequent intervals it will have a controlling effect on some weeds. Alternatively, if the herbage is allowed to come up to the hay stage this in itself will have a deleterious effect on clover. Some compromise, therefore, has to be found between these two extremes in the hope that it will not unduly affect the weeds and will not have a detrimental effect on clovers. Also the stage of the cut should, as far as possible, be related to agricultural practice. A cut at the silage stage is such a compromise and was used in the trials reported in this work.

With full knowledge of the limitations of this type of experiment four trials were carried out during 1956 and 1957, designed to study the effect of MCPA, MCPB and 2,4-DB on botanical composition and productivity of permanent pasture.

The following conclusions may be drawn from this series of trials:—

1. The use of selective weedkillers normally gives a satisfactory control of *Ranunculus repens* and *Cirsium arvense* in permanent pasture without affecting the production of green matter of that pasture.

2. That under the type of management practiced in these trials MCPA was a better weedkiller then MCPB or 2,4-DB.

3. For any quantity of weeds in the pastures investigated the production of grass and clover was reduced by a similar amount.

4. The method of assessing productivity used in the trial did not fully bring out the advantages obtained from successful weed control. A mower cuts off weeds, grass and clover alike, whereas a grazing animal is more selective. A larger part of the production from weeds is not used by the animal and is wasted together with part of the surrounding grass and clover.

5. It is necessary in productivity work of this type to take samples of cut herbage and to separate out the weeds from the grass and clover to determine what proportion of the total production is made up of weeds.

6. The use of silage cuts for two years as a means of assessing the productivity of a sward is not suitable as it severely reduces the amount of clover present.

*(continued on page 81)*

# The African Pyrethrum Industry and Properties of some Synergists

A RECENT REVIVAL of interest in the use of pyrethrum for horticultural and agricultural pest control was referred to by Dr. T. F. West, D.Sc., (African Pyrethrum Technical Information Centre Ltd.), when he addressed the Industrial Pest Control Association in London on 7th October. Mr. A. Frazer McIntosh (Thomas Harley Ltd.), presided.

Reviewing the properties of Pyrethrum, Dr. West noted the following:—

Its non-toxicity to warm blooded animals: its special property of paralysis or " knockdown " which had never been reproduced satisfactorily by any other insecticide.

Pyrethrum in the correct concentration in a suitable diluent could be applied frequently for housefly control. As far as was known, there was no record that in so doing a poisonous deposit was accumulated, or that taint, off-flavour or smell was caused even where food was exposed.

As a result of the increased emphasis on the safe control of insects affecting man, animals and foodstuffs, pythertum insecticides were preferred for use in mills, warehouses, factories, hospitals, restaurants and other places where food is handled and stored.

Owing to its non-toxic nature pyrethrum would appear to offer advantages when applied to crops close to harvest.

No matter how frequently pyrethrum is used, no case of insect resistance of any practical significance appears to have been reported.

The addition of " synergists " has made economically possible the use of pryethrum to a far greater extent than formerly, by increasing its knockdown and killing power.

Insecticidal formulations, said Dr. West, based on pyrethrum, were widely used in: household flysprays and aerosols, food processing factories, food warehouses, the tobacco industry, grain stores, public health pest control, pest control in ships, aircraft insect quarantine, pest control on domestic and farm livestock.

" Pyrethrum is a contact insecticide and has little or no stomach poison action. It exerts a characteristic effect on the nervous system of insects, resulting in muscular excitation, inco-ordination, convulsions and paralysis. The rapidity of the effect of pyrethrum is demonstrated by the excitement with which cockroaches emerge from their hiding places and race about when treated with sublethal dosages of pyrethrum dust or spray," observed Dr. West.

The properties of known synergists were later discussed by the speaker.

Discussing Fisons Pest Control Limited in his annual statement circulated with the sixty-fifth annual report and accounts of Fisons Limited, for the year ended 30th June last, Sir Clavering Fison, D.L. (Chairman, Fisons Limited) observes that the year under review was the first in which Fisons Pest Control had introduced any new products of major importance.

" Both the products themselves and the way in which we were able to launch them gave me confidence that the worst of this Company's troubles are now past," he states.

Referring to the arrangements for collaboration with J. R. Geigy, S. A. the inventors of D.D.T., Sir Clavering thinks that both Companies are profiting from this association.

" While there is no financial connection between the Companies the collaboration in the field of pest control is close and I think that our co-ordinated effort now places us in the very first rank in this industry in the world."

# fluoroacetamide

## " considerable additional evidence for . . . . . "

The Editor,
Pest Technology.

Dear Sir,

With reference to Dr. David's very interesting paper in " Pest Technology " for November, 1958, there is considerable additional evidence for the fact that fluoroacetamide is a very effective general aphicide at very low concentrations (1 in 20,000 to 1 in 50,000) and has been effectively used against aphid pests of rose bush, winter carnation, chrysanthemum to mention only three non-edible plants and against sugar beet aphid, aphid pests of spring cabbage, brussels sprouts, field beans and broad beans, and a number of fruit trees and bushes.

" Tritox " systemic insecticide which is marketed for use against aphids of non-edible plants, contains acetamide, which as Dr. David points out, is an antidote against experimental poisoning of animals with fluoroacetamide; a number of other $C_2$ compounds are also protective and/or antidotal against fluoroacetamide toxicity and this firm holds master patents for the use of such materials in conjunction with fluoroacetamide used as a pesticide. So far, fluoroacetamide formulations such as " Floron " and " Megatox " (also systemic insecticides) have only received clearance for use against aphid pests of sugar beet, where they appear to be very effective in reducing the incidence of virus yellows but it is hoped to obtain clearance in due course for the use of Megatox v. aphids of a number of other edible crops.

Yours faithfully,

for Associated Fumigators Limited,

M. A. Phillips,
*Chief Chemist.*

Associated Fumigators Limited,
112 Victoria Dock Road,
London, E.16.

14th November, 1958.

# CORRESPONDENCE

The Editor,
Pest Technology,

Dear Sir,

I have read with particular interest the article upon "Weedkillers—a Decade of New Developments" by R. S. L. Jeater, B.Sc., and H. P. Allen, B.Sc., Ph.D., in your current issue.

I was particularly interested in their statement that MCPA and 2,4-D deal effectively with creeping buttercup in grassland. So far I have found the creeping buttercup reasonably resistant to both the above and the bulbous buttercup, whilst temporarily checked, is quite resistant to both.

I should be most grateful if you would let me know the recommended rates and season of application necessary to control the above, and also if the authors could express their views upon suitable selective weedkillers to control the growth of self heal in grassed down orchards.

Yours faithfully,

T. H. Iddison,

*Chief Public Health Inspector*,
Borough of Dartford,
Public Health Department,
Market Street,
Dartford, Kent.

13th November, 1958.

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T. H. Iddison, Esq.,
Chief Public Health Inspector,
Borough of Dartford,
Public Health Department,
Market Street,
Dartford, Kent.

Dear Mr. Iddison,

I must thank you for your enquiry concerning a point which was made in the article upon "Weedkillers" written by Mr. Jeater and myself and appearing in the current issue of "Pest Technology". The Editor of that periodical has kindly sent me on a copy of your enquiry.

MCPA and 2,4-D are extremely effective on creeping buttercup in grassland. I should say that of all the weeds in pasture creeping buttercup is the easiest to eradicate with chemicals and a rate of 1½ lb. of active acid equivalent of either MCPA or 2,4-D formulations (sodium salt, potassium salt or amine) will be very effective on the weed. The best time to apply the chemical from the point of view both of weed control and of minimal effect on clover in the sward, is probably just before flowering and in some cases rates lower than those I have mentioned can be very effective. In fact the recent publication by the British Weed Control Council on "Weed Control" points out that the best time for treatment of this weed with MCPA or 2,4-D is "in spring or early summer up to flowering during which time ¾-1½ lb. of the chemicals per acre are recommended." The B.W.C.C. add that "successful treatment may, however, be made at any time of the year during active growth of the weed but for treatment outside the optimum time mentioned above, the dose should be increased to 1½-2 lb. per acre."

In our experience MCPA is more effective than 2,4-D for creeping buttercup and this point is also made in the B.W.C.C. handbook.

I note your remarks about bulbous buttercup being resistant to MCPA and 2,4-D; this is certainly true. Spring treatment with either MCPA or 2,4-D will probably be successful in preventing flowering in the season of treatment but is unlikely to result in a significant reduction in the year after treatment. Referring again to the handbook the suggestions made there are that as bulbous buttercup seed germinates in the autumn it is possible that treatment of the weed with MCPA or 2,4-D may be more effective in the autumn than in the spring.

I have confined my remarks so far only to weed control but obviously in grassland one has to think of the weed control treatment as part of a general programme of pasture improvement. Much of the permanent pasture in which creeping buttercup appears as a serious weed is run-down grassland where the clover content is quite low, and experiments have shown that under such conditions the use of MCPA and 2,4-D would have no serious effect on the pasture through depletion of clover population; but having killed the weed it is necessary to consider measures to improve the general condition of the pasture so that the weeds may be replaced by nutritive herbage and not by a new generation of broadleaved weeds or inferior grasses.

If you are interested to any extent in weed control, I would recommend unreservedly that you spend 12/6d. on purchasing the recently published handbook of the British Weed Control Council, to which I have referred in this letter; it is published by Blackwell Scientific Publications and would be well worth your money.

1. Self heal as a weed is not very susceptible when established, though with MCPA at 1½ lb. per acre or 2,4-D amine at 1¼ lb. per acre good control may be obtained on occasions provided attention is given to the timing of the treatment.
2. In a grassed down orchard you naturally have to think of the safety of the trees when you are planning your weedkilling treatment. You may use MCPH or 2,4-D up to a maximum dose of 2 lb. per acre for the control of weeds in apple orchards but naturally you must take great care to see that the spray does not come in contact with the trees. This means in particular that you must take precautions to avoid drift because hormone weedkillers like MCPA or 2,4-D can cause serious damage to fruit trees.

If your problem permits the best approach would be to "spot treat" by means of a knapsack type sprayer. You really have a problem similar to that on lawns and probably your best plan would be to treat with a knapsack sprayer 2 or 3 days after you have cut the grass some time in early summer.

All in all, the use of MCPA and 2,4-D in a grassed down orchard can be a fairly safe proposition provided you take great care. More than that I cannot say.

Yours sincerely,

H. P. Allen,

*Technical Department*,
Plant Protection Ltd.,
Research Station, Fernhurst,
nr. Haslemere, Surrey.

18th November, 1958.

# Correspondence from . . .

## HARTLEPOOLS, SUNDERLAND, CLIFTON, NEW JERSEY

The Editor,

Pest Technology.

Dear Sir,

I was very much interested in an article on the furniture beetle in your publication "Pest Technology." Therein it recommends an insecticide for use against the wood boring insects based on Polychlornaphthalene.

I would be much obliged it you could advise me of insecticidal firms who market this compound as we are having a considerable amount of trouble with these insects in Corporation houses in this town.

As you will appreciate most disinfestants are advertised under proprietary names and it is sometimes difficult to ascertain the actual ingredients.

Yours faithfully,

G. A. Ward,

*Senior Public Health Inspector.*
Borough of Hartlepool Health Centre,
Frederic Street, Hartlepool.

(*We passed on this correspondence to the writer of the article for his attention. Ed.*)

3rd November, 1958.

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Editorial,

Pest Technology.

Gentlemen:

In your first issue of "Pest Technology" on page 24 reference is made to the Annual Report just issued by the Medical Officer of Health for Rochdale (John Innes, M.D., D.P.H.) for the year 1957. The report makes reference to "the development of bait preservatives for rats."

We are interested in obtaining more information about the preservatives used for rodenticide baits. Could you tell us where we may obtain a copy of the report mentioned above, or how we may contact the Medical Officer directly?

We were quite impressed by your first issue of Pest Technology. We hope that your new venture will be a highly successful one.

Very truly yours,

Morton Schwarcz,
*Manager*
*Applications Laboratory*,
Shulton Incorporated,
Route 46, Clifton, New Jersey.

7th November, 1958.

(*We have supplied the information requested. Ed.*)

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The Editor,

Pest Technology.

Dear Sir,

I have received a copy of the second edition of "Pest Technology" and feel that I must proffer my congratulations to those responsible for introducing a journal which is so informative upon a subject which is of great importance to all officers who are engaged in the public health services.

Port Health Inspectors are continually faced with the problems associated with the infestation of vessels arriving from all parts of the world and it is essential that if they are to carry out their duties efficiently in this particular field they should be made aware of the up-to-the-minute advances in the science of pest technology.

As the Hon. Secretary of the Sea and Air Port Health Inspectors Branch of the Association of Public Health Inspectors I can vouch for the fact that members of the Branch would be most grateful if they could receive copies of this journal from time to time and I should be pleased to furnish a list of the official names and addresses of the chief inspectors engaged in the various ports in England and Wales if requested to do so.

Many thanks.

Yours sincerely,

C. Pickering,

*Chief Port Health Inspector*,
Sunderland Port Health Authority,
Corporation Quay, Sunderland.

8th November, 1958.

(*We are attending to this. Ed.*)

## NEW PRODUCTS

With the rapid growth of broiler production in this country the main problem facing producers has been the extent of feather-pecking and cannibalism among birds. Extensive tests have proved that the trouble has been practically eliminated by an application of "Spray-mite," recently introduced, after extensive tests, by H. E. Helman (Insecticides) Ltd. Its effectiveness limits the necessity to spray more than once in the ten weeks of production, at a cost of 1½d. per bird. It is also being used on birds on open range without ill-effects on egg production.

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British Bitumen Emulsions Ltd., Dundee Rd., Trading Estate, Slough, have developed the "Isoseal" for wood floors. It is described as a new Oleoresinous Deep Seal Coating.

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A new packaging medium, said to be "a perfect barrier to the passage of moisture-vapour and oxygen" has been developed by Fisher's Foils Ltd., of Wembley, Middlesex. It is an aluminium foil on to which polythene has been extruded.

An official of the firm said that this packaging would, it was thought, be a suitable container for some of the pesticide concentrates.

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Vigzol Oil Company Limited (Agricultural and Chemicals Division), Vigzol House, Greenwich, London, S.E.10 have designed the "Everyman" sprayer

The sprayer is a tractor mounted low volume sprayer specially designed for mounting into the hydraulic linkage of all popular makes of British tractors in current production.

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A circular issued in early November by The Murphy Chemical Co., Ltd. refers to the company's intention to maintain the range of insecticides—through its Murphex Division—relative to insect control and to extend the range as new insecticides become available.

The new Malathion Wettable (Dispersable) Powder for stored grain, as recommended by the Ministry, has recently been added to the range.

# NEWS

### Wheat Bulb Fly

In spite of the wet summer many more wheat bulb fly eggs have been laid this year in the East Midlands area, including Lincolnshire, and in East Anglia than for some time. Dangerously high numbers have been found on a high proportion of fields which have been bare fallowed or where early potatoes or vining peas have been grown, states the Ministry of Agriculture, Fisheries and Food.

In areas where this pest is often troublesome, farmers who intend to sow winter wheat on such fields are advised to take precautions to reduce the risk of damage. Fields sown in good time say, up to the end of October, rarely suffer serious loss.

Although no form of chemical control is always completely effective there are several materials which give some protection particularly on later sown crops. Seed dressings containing at least 40% gamma BHC, dieldrin or aldrin in addition to the usual organo-mercurial fungicides and applied at 2 oz./bushel are the cheapest and usually the most effective methods. The germination of grain containing over 16% moisture may be affected by seed dressings particularly those containing gamma BHC. This material is however the most effective seed dressing on crops sown very late, e.g. after mid-December. Deep drilling should be avoided as it not only delays germination but there is some evidence that it reduces the effectiveness of the seed dressings.

Combine drilling of aldrinated fertilizer so that at least 1 lb. of actual aldrin is applied per acre can also give a useful control and may be particularly valuable where the seed has already been dressed with organo-mercury only or the lower percentage wireworm dressing.

### Payment of Grant

The first payment of grant under the £ for £ scheme has been made to the Rhydlewis and District Rabbit Clearance Society in Cardiganshire, announces the Ministry of Agriculture, Fisheries and Food. Application for grant was received on 14th October and the cheque was sent the 17th October. This was an interim payment made on audited accounts covering the first three months of the Society's operations.

*Note:* Grants are offered to groups of farmers and others who set up rabbit clearance societies to take combined action against rabbits. The basis of the grant is £1 for each £1 subscribed by members and is payable on production of audited accounts of approved expenditure on rabbit control.

The Rhydlewis Society covers nearly twenty thousand acres and the members contribute 1/- per acre. It employs two operators and commenced operations on 2nd June, 1958

There are now forty-four rabbit clearance societies operating in England and Wales.

### The Fire Blight Disease Order, 1958

As from 6th November, growers in England and Wales of fruit or other trees infected with fire blight disease were required to notify the fact to the Ministry of Agriculture, Fisheries and Food. This is one of the effects of an Order made on 5th November with a view to preventing the spread of this most serious bacterial disease of trees which was recently confirmed in this country for the first time.

The Order empowers the Minister to serve notices on occupiers of land requiring them to destroy any trees or parts of trees infected or suspected of being infected with the disease or to take any other steps to prevent the disease spreading. Such notices may also prohibit the removal of trees, pollen, budwood, scions or other parts of any trees from affected premises and the movement of beehives on to or away from the premises except under the authority of a licence issued by the Minister.

The Order, entitled "The Fire Blight Disease Order, 1958" (S.I. 1958 No. 1814) has been made under the Destructive Insects and Pests Acts, 1877 to 1927. Copies may be obtained from H.M.S.O., York House, Kingsway, London, W.C.2, or from any bookseller, price 3d. (by post 5d.).

### Fowl Pest in Norfolk

There have been no recent outbreaks of fowl pest in the 32 parishes north-east of Norwich. The Infected Area restrictions on the movement and marketing of poultry are being withdrawn accordingly on the 23rd November, states the Ministry of Agriculture, Fisheries and Food.

Poultry-keepers are reminded of the following regulations which remain in force:—

(1) Live poultry must not be moved from any premises on to which live poultry or poultry carcases (other than those intended for consumption) have been moved within the previous 28 days.

(2) Auction sales of store poultry at markets may not be held until after 31st December.

(3) In addition, restrictions imposed on particular places by any notice under the Fowl Pest Order of 1936.

Occasional outbreaks of fowl pest continue to occur in East Anglia. Proper care can reduce to a minimum the risk of the spread of infection and all whose business involves the handling of birds or poultry carcases should continue to pay particular attention to the maintenance of a high standard of hygiene.

### National Egg Laying Test

When he spoke at the Diamond Jubilee Dinner of the National Egg Laying Test, Mr. Joseph Godber, M.P. (Joint Parliamentary Secretary to the Ministry of Agriculture, Fisheries and Food) said that not everyone now remembered that the real campaign against poultry disease began only just before the war.

Today pullorum disease had been brought under virtually complete control; yet just before the war 60 per cent of the batches of chicks inspected at the Ministry's laboratory at Weybridge were found to be infected with it.

# NEWS

### New Appointments

Mr. N. F. McCann, B.Sc., N.D.A., Deputy Regional Director, Yorks. and Lancs. Region, is transferring to the East Midland Region on the 10th November, 1958, to replace Mr. R. J. Kerr, N.D.A., N.D.D., who recently retired.

Mr. T. C. Creyke, N.D.A., N.D.D. at present Agriculture and Food Adviser to the office of the High Commissioner for the United Kingdom in Australia, will replace Mr. McCann at Leeds (Yorks, and Lancs. Region) on his return to the National Agricultural Advisory Service.

Mr. J. Howard Morgan, B.Sc., County Advisory Officer in Monmouth is to be appointed Deputy Regional Director at Cardiff Sub-Centre in succession to Mr. W. Williams, M.Sc., who is retiring on 31st December, 1958.

Esper K. Chandler, assistant professor of agronomy research at the Louisiana State University's North Louisiana Hill Farm Experiment Station, has been named district representative of the National Plant Food Institute for the South-eastern regional office at Atlanta.

Mr. Chandler received his Bachelor of Science degree in general agriculture and rural sociology in 1948 from Louisiana State University and his Master of Science degree in soils from the University in 1955.

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### NEW TELEPHONE NUMBERS

From December 1st the telephone numbers of the Northern Sales Division of Shell Chemical Co. Ltd. will be changed to DEANSGATE 2411-2420. The address, 144/6 Deansgate, Manchester 3, is unaltered.

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### Fluid Topics

*Published by Jeyes' Sanitary Compounds Company Ltd., 31 River Road, Barking, Essex.*

Contains several articles which may be read with interest and improvement.

The Annual Dinner of the Industrial Pest Control Association was held at the Trocadero Restaurant, Piccadilly Circus, London, W.1, on Tuesday, 18th November, 1958. The Right Honourable Earl Waldegrave, Parliamentary Secretary (Lords) to the Ministry of Agriculture, Fisheries and Food, who was the principal guest, proposed the toast of "The Association." This was replied to by the President of the Association, Mr. A. Fraser McIntosh. Mr. D. J. S. Hartt, Vice-President of the Association proposed the toast of "The Guests," which was replied to by Colonel H. J. Wilson, Vice-President of the National Farmers Union. One hundred and twelve members and guests were present at the Dinner.

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### Prosecution of Firm under the Agriculture (Poisonous Substances) Regulations, 1956-1958

Fines totalling £45, with 10 gns. costs, were recently imposed on a firm of agricultural spraying contractors. The firm was prosecuted under the Agriculture (Poisonous Substances) Regulations for permitting two of its employees to carry out spraying operations with a scheduled poisonous substance without wearing the prescribed protective clothing, and for failing to provide the employees with adequate personal washing facilities.

The employees were granted a conditional discharge on payment of costs.

The Agriculture (Poisonous Substances) Regulations require employers to provide and workers to wear prescribed protective clothing when mixing or applying—

amiton and its salts
DNC (DNOC)
dinoseb (DNEP)
demeton
demeton-methyl
dimefox
endrin
fluoroacetamide
mazidox
mipafox
parathion
"Phosdrin"
potassium arsenite
schradan
sodium arsenite
sulfotep
TEPP (HETP)
Organo-mercury compounds (when used as aerosols)

Other requirements of the regulations include the provision of washing facilities and the keeping of records.

### DATES FOR THE DIARY

(*Hon. Secretaries are invited to send in details for inclusion in this column*).

1st-4th December.

Entomological Society of America (Sixth Annual Meeting). Hotel Utah, Salt Lake City, Utah.

5th December.

Society of Chemical Industry (Pesticides Group) (Jointly with Agriculture and Fine Chemicals Groups): Dr. P. W. Brian "The effects of gibberellic acid on plant growth and developments," and Dr. B. E. Cross "The chemistry of gibberellic acid." 14 Belgrave Square, London, S.W.1.

5th December.

Association of Applied Biologists: After the formal business of the meeting, the programme will be as follows:—

(morning)

DR. H. R. WALLACE (*Rothamsted Experimental Station*):
"Observations on the movements of eelworms."
DR. H. D. BURGES (*D.S.I.R. Pest Infestation Laboratory, Slough*):
"The ecology of the Khapra beetle in maltings."
MR. D. C. DRUMMOND (*M.A.F.F. Infestation Control Laboratory Tolworth*):
"Some aspects of the ecology of rats on a Hampshire farm."

(afternoon)

DR. R. C. F. MACER (*Plant Breeding Institute, Cambridge*):
"The saprophytic activities of *Cercosporella herpotrichoides*."
MR. J. P. CLEARY (*N.A.A.S., Leeds*):
"Bacterial wilt disease of lettuce."
DR. I. ISAAC (*University College of Swansea*):
"Some aspects of Verticillium wilt of lucerne."

6th January, 1959.

Plant Phenolics Group. Meeting: "Chemistry of Condensed Tannins." Chairman: Prof. R. D. Haworth, F.R.S. Speakers will include Drs. B. Brown, D. E. Hathway, W. E. Hillis, E. A. H. Roberts, D. Roux and T. Swain. Queen Elizabeth College, London, W.8 (further information may be obtained from the Hon. Sec., Dr. T. Swain, Low Temperature Research Station, Downing Street, Cambridge).

# BOOK REVIEWS

**Weed Control Handbook.**

*Issued by The British Weed Control Council, and published by Blackwell Scientific Publications, Oxford. Price* 12*s.* 6*d.*

As Professor H. G. Sanders, M.A., Ph.D., Chief Scientific Adviser to the Minister of Agriculture and President of the British Weed Control Council observes in his preface, " The continuing rapid development of chemical weed control has demanded a new edition of the handbook every year. Each year has seen improvement until the point has now been reached when a more permanent form of the handbook seems warranted. This new edition may now not be revised for a year or two."

Professor Sanders goes on: " The handbook is intended for all who are interested in the practical or the technical aspects of the subject and the aim has been to make the volume complete, to cover all questions that can arise in the chemical control of weeds."

In this the Council has succeeded admirably. The writer has not had the opportunity of seeing previous handbooks issued, so that it is difficult to make comparisons: but it is clear that the present publication is far more ambitious and beyond the scope of a handbook as the term is understood normally. The term, however, has no doubt attained a meaning all its own in the nomenclature and is regarded as more or less standard.

As a standard work of constant reference, the handbook has much to commend it. The price is modest in the extreme, and will ensure purchase by the greatest number and thereby the attainment of maximum results.

Probably one of the main attractions of this volume is its essentially practical approach to the subject of weed control. There is no " woolly" thinking on the subject; it is direct and concise to a degree.

Following an introduction to herbicides, there is an extremely informative section dealing with recommendations and information concerning the use of herbicides. The publication of tentative definitions, too, is advantageous.

Horticulture, forest nurseries, lawns and sports' turf all find a place and special weed problems are also discussed, as is non-selective weed control.

One could have wished for a more lengthy section on the mechanics of application. It is perhaps a moot point as to whether comparisons of one system as against another would have been an advantage.

Legal aspects and insurance find a not uninteresting place, and in Part IV Weeds and Weed Seeds, the law relating to these will prove invaluable for the user, as will the various seed certification schemes, which are listed.

Approved and new herbicides are discussed, and there is a comprehensive Glossary of Technical Terms, a List of Common Names and Chemical Abbreviations and a very full list of the properties of herbicides, listed in table form. The index covers some 13 pages—an indication of the scope of the work—and there are some 245 pages exclusive of preface and contents' pages.

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**Checklist of the Millipeds of North America.**

*By Ralph V. Chamberlin (Department of Zoology, University of Utah) and Richard L. Hoffman (Department of Biology, Virginia Polytechnic Institute). Published by Smithsonian Institution, Washington, D.C.*

This is Bulletin 212 of the U.S. National Museum and apart from the first class catalogue which the colume is, contains a most enlightening introduction including a reference to Ordinal nomenclature.

**Checklist of the Coleopterous Insects of Mexico, Central America, the West Indies, and South America.**

*By Richard E. Blackwelder. Published by Smithsonian Institution, Washington, D.C. Price* $2.25.

This is Bulletin 185 (Part 6) of the United States National Museum, and is remarkable in its comprehensive range.

The contents include an Introduction, Bibliography, Journals and abbreviations Corrigenda, new proposed names and an index to general and higher categories.

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## PUBLICATIONS RECEIVED

**Malathion folders: " Animal and Poultry Guide :" " Health and Household Guide."**

*Published by Cyanamid of Great Britain Limited, Bush House, Aldwych, London, W.C.*2.

**Roche 1908-1958.**

*Published by Roche Products Limited.*

A well-written, admirably illustrated booklet of some 124 pages, published to mark the Golden Jubilee of the firm in Great Britain.

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**Pyrethrum Post.** No. 4, Vol. 4.

*Official Publication of the African Pyrethrum Technical Information Centre Ltd., P.O. Box* 420, *Nakuru, Kenya Colony.*

A mine of information relating to the uses of Pyrethrum. One article of particular interest is that by Messrs. N. G. McTaggart, E. Thornton and A. D. Harford (The British Petroleum Company Limited, Research Station, Sunbury-on-Thames, Middlesex) entitled, " The Determination of Pyrethrins and other Insecticidal Compounds by Infra-Red Spectrometry."

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**Wood Preservation Leaflets 1-10.**

*Issued by The British Wood Preserving Association,* 6 *Southampton Place, London, W.C.*1.

When leaflet No. 7—The Common Furniture Beetle—is distributed a list of suitable insecticides is attached.

**" . . . . weed competition in the early seedling stages of a direct sown lucerne."**

## 2,4-DB and MCPB in LUCERNE. Part II. The Use of 2,4-DB in the establishment of lucerne leys.

*By* R. W. E. Ball and C. W. Wilson.
*Agricultural and Horticultural Research Station, May and Baker Ltd., Ongar.*

With the introduction of MCPB in 1954, a safe selective herbicide for use in the early stages of the establishment of both red and white clovers has been available to farmers. This herbicide, however, has been found to be too injurious to young lucerne, but greenhouse experiments have shown that the butyric homologue of 2,4-D is far less phytotoxic.

Field experiments, under as wide a range of conditions as possible, were therefore undertaken in 1957 to evaluate the potentialities of 2,4-DB as a herbicide in seedling lucerne. Unfortunately, at the time when the experiments were planned, petrol rationing was in force, and the experiments had to be carried out within a few miles of our Research Station at Ongar. The range of soil conditions and weed populations was therefore very much restricted.

The main emphasis was on the effects of treatment on direct sown lucerne, because it was easier to obtain immediate yields and consequently to follow the recovery of the lucerne during the succeeding year. Comparison of treatments on both direct and undersown crops was, however, made in two of the experiments.

MCPA was included, because at low dose rates a good control of certain annual weeds such as Charlock (*Sinapis arvensis*) and Fat hen (*Chenopodium album*) can be obtained.

The best, and most consistent, weed control was obtained with the ester, which gave excellent kills of Fat hen, Knotgrass, Orache and Perennial sow thistle. Control of Black bindweed was fair to good, and the control of Creeping thistle was generally rather erratic. The sodium salt was only a little inferior to the ester in most cases, but larger dose rates were needed and timing was very much more important. This was particularly the case with Knotgrass, which was well controlled by the first spraying but which became almost resistant by the time of the second spray. The low rates of MCPA were only sufficient to give a good control of Fat hen (at 8 and 16 oz.), and a fair control of Orache. The *Polygonum* species were almost completely resistant to 16 oz. of MCPA.

*Included in the photograph are—*

*Mr. R. H. Beatty (Weed Society of America) E. K. Woodford, Esq., Department of Agriculture, Oxford, (Speaker). Dr. Ir. W. Van der Zweep, I.B.S. Wageningen, Netherlands, R. S. L. Jeater, Esq., Plant Protection Limited, J. D. Reynolds, Esq., Pea Growiing Research Organisation, (Speaker)*

### Effect of treatment on undersown crops

No yield assessments on undersown lucerne could be made during the year of sowing, but comparison with the direct sown crops was made at the first harvest cut in the following year. With few exceptions, the results on the undersown crop follow closely those of the comparable 1958 figures for the direct sown.

### Discussion

The large increases in yield obtained in these experiments show that weed competition in the early seedling stages of a direct sown lucerne ley can exert a considerable adverse effect on the plants, and that early removal of this weed competition can result in substantial increases in harvest yields during the year of seeding. In the three experiments where both weed and lucerne weights were recorded there were sufficient control plots present to obtain a wide range of both weed and lucerne weights. Statistical analysis showed that the linear regressions of lucerne on weeds were highly significant in the experiments containing mixed weed populations, but not where Knotgrass rapidly became the dominant species.

**". . . difficult to assess the relative importance of the height of regrowth."**

## 2,4-DB and MCPB in LUCERNE—Part III—The effects of MCPB and 2,4-DB on established lucerne.

*By* R. W. E. Ball and C. W. Wilson,

*Agricultural and Horticultural Research Station, May and Baker Ltd., Ongar.*

During 1957 2,4-DB was evaluated as a herbicide in seedling lucerne. As a result of these experiments 2,4-DB was made available to farmers in Britain early in 1958, and since then many requests for information on its suitability in established crops have been received. Little published information of work in this country is available, though one experimentt was reported in the proceedings of the last Weed Control Conference.

Two experiments were therefore laid out in 1958, both in 1 year old stands, to determine the effect of applying 2,4-DB and MCPB at different stages of growth of lucerne, MCPB was included because a number of reports particularly from overseas, have suggested that this material is reasonably well tolerated by established lucerne. In neither of the experiments were either broad leaved or grassy weeds a problem, the main purpose of the experiments being to determine the toxicity of the materials to the crop in the field.

### Results

The six varieties in Experiment I were recorded separately, but the analysis of variance showed that there were no differences in varietal reaction to any of the chemicals.

The harvest in Experiment 2 was not completed until the end of August, with the result that in the short time available for the writing of this report it has only been possible to analyse in detail the figures of the lucerne fraction of the grass-lucerne mixtures. The individual plot variation in this experiment was higher than in Experiment I and although the reaction of the lucerne in the three swards appears to show noticeable differences, these are not statistically significant.

### Discussion

The results of these experiments have confirmed those of other workers that 2,4-DB is less toxic to established lucerne than MCPB, particularly at rates of 24 and 32 oz., which in this country would be essential for a good control of the main broad leaf weeds (Creeping thistle *Cirsium arvense* and Docks *Rumex spp.*) that occur in established lucerne stands. Of the two 2,4-DB formulations, the sodium salt gave consistently higher harvest yields than did comparable rates of ester. At 16 oz. MCPB compared favourably with the sodium salt of 2,4-DB but at 32 oz. the yields with the former were very severely depressed.

With the exception of the three 2,4-DB sodium salt treatments at an early growth stage in Experiment 1, all treatments gave significant reductions over the controls. It must be remembered, however, that in neither of these experiments was the broad leaf weed population of any magnitude (for most plots the weights of weeds were approximately 1% or less), and in farm conditions the spraying of such crops would not normally be contemplated. A severe infestation of docks and thistles would almost certainly have reduced the control weights.

From the limited amount of data available, it is difficult to assess the relative importance of the height of regrowth at spraying and the interval between spraying and harvest as factors influencing the final weights at harvest. It is obvious, however, that some check to the lucerne is unavoidable, and the earlier the spraying is carried out after a cut, the longer the crop will have in which to recover before its next defoliation. In a vigorous grass sward, such as occurred in Mixture B (Experiment 2) this recovery may be further hampered by the competition from the grasses, or, in pure lucerne stands, from any weed grasses present.

In the field, the plots sprayed early tended to appear worse for about 10 days after spraying, than those sprayed later, mainly because the plants in the latter had a greater amount of normal foliage before the treatments effect appeared. At harvest time, however, there was little difference in appearance between the two sprayings.

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## SELECTIVE WEED CONTROL IN CEREALS WITH CMPP AND SODIUM MONOCHLOROACETATE

*by* A. F. J. WHEELER, *Plant Protection Ltd., Fernhurst Research Station.*

A series of trials was laid down to evaluate alpha (4 - chloro - 2 - methyl phenoxy) propionic acid (CMPP) in comparison with sodium monochloroacetate as selective herbicides in cereals, particularly crops infested with *Galium aparine* (cleavers) and *Stellaria media* (chickweed).

2.5 lb./ac. CMPP was very effective against *Galium aparine*, 2 lb./ac. was unsatisfactory for control of over-wintered infestations in winter cereals. *Stellaria media* was eradicated with 2 lb./ac. CMPP.

Sodium monochloroacetate was generally disappointing against these weeds. The standard dosage rate of 20 lb./ac. reduced *Galium aparine* by 59% and *Stellaria media* by 63% on an overall average. *Polygonum persicaria* (redshank) and *Polygonum convolvulus* (black bindweed) are very susceptible to sodium monochloroacetate.

Both CMPP and sodium monochloroacetate caused a negligible incidence of malformity to wheat, oats and barley sprayed early, and neither material caused significant reductions in yields of these crops.

CMPP was more effective than MCPA / sodium monochloroacetate mixtures when applied to mixed stands of *Galium aparine* and *Chenopodium album* (fathen). Cereal yields were not significantly reduced by spray applications of 1.5 lb. MCPA/ 20 lb. sodium monochloroacetate per acre.

### Discussion

On the evidence of these trials it can be concluded that CMPP is a

**" . . . if the manufacturers' recommendations had been followed."**

more efficient selective weedkiller than sodium monochloroacetate for use in cereals infested with *Galium aparine*, *Stellaria media*, *Chenopodium album* and *Papaver* sp. Sodium monochloroacetate is the better material for control of *Polygonum persicaria*, and probably *Polygonum convolvulus*.

Mixed infestations of *Galium aparine* and *Chenopodium album* can be effectively dealt with by CMPP without resorting to mixtures of MCPA/sodium monochloroacetate.

**CONTROL of GALIUM APARINE with MCPP in FRANCE.**

*by* Jean Lhoste, Antoine Casanova and Philippe Stouff, *Labatoire des Pesticides, Procida.*

Chemical weed control in cultivated plants was sometimes quite difficult to carry out: difficulty in using a recommended control method, weed species resistant to usual chemicals.

It was therefore necessary to experiment new weed-killers whose properties would complete those of common chemicals such as DNOC 2, 4-D, MCPA. etc.

Some experiments had been conducted with a product from Boots Pure Drug Co. Ltd., Nottingham. This chemical, alpha (4-chloro-2-methyl phenoxy) propionic acid, is known to have a selective phytotoxicity on Galium.

Results were obtained in treated and untreated plots in collecting all weeds in 4 different places of 1 sq. meter each. Plants were counted and weighed.

In plots treated with MCPP at the rate of 2.7 kg. per hectare, an average of 13 Galium per sq. m. was found. Weeds having an average rate of about 1.1 g. were severely injured at the very moment when counts and tests weight were made. Malformations shown by *Galium* treated with MCPP-K consisted particularly of the bringing nearer of the internodes at the head of the plants: the abnormal development of roots on the stem: leaves and the whole vegetative system getting red: *Galium* did not stand vertical any more and looks like creeping plants. Furthermore, quite a number of weeds were killed after some time in areas where no collect was made.

On the contrary, in plots treated with DNOC-NH4, plantlets being found in a greater number and having an average weight of 0.9 g. were young plantlets which germinated a long time after the herbicide was applied.

At the time of harvest, count of *Galium* seeds per 1,000 wheat seeds gave significant differences at the 5% level of significance between plots treated respectively with 1.4 kg., 2 kg. and 2.7 kg. of MCPP-K per ha. Only MCPP-K at 2.7 kg. gave a complete kill.

It is therefore possible to get a complete control of *G. aparine* either in treating with DNOC-NH4 or with MCPP-K. With the former product, the rate of 2.4 kg./ha. is sufficient provided that the treatment is taking place when *Galium* is in the 2 leaf stage maximum. With MC PP, it is possible to treat later and this year, in our experiments, the right time for treating was from 15th April to 10th May, i.e. during more than 3 weeks.

Many tests evidenced that the right dosage is 2.7 kg./ha. and the quantity of water: 200, 400 or 1,000 litres per hectare.

**THE RELATIVE SUSCEPTIBILITY OF CEREAL VARIETIES TO GROWTH REGULATOR HERBICIDES. Some preliminary investigations with MCPA and 2,4-D, (also CMPP and 2,3,6-TBA).**

*By* C. S. Elliott, *National Institute of Agricultural Botany.*

With the great increase in use during recent years of the growth regulator herbicides there have been various reports by farmers and others of varietal differences in susceptibility to spray damage. A most striking example occurred in a spring oat variety trial at Sutton Bonington in 1955. This trial was sprayed with a commercial 2,4-D (ester) preparation at 4 oz./acre just before shooting. Of the six varieties included in the trial only two, namely, Blanche de Wattines and Flamande Desprez were severely damaged. These closely related French varieties developed marked symptoms of spray damage. The flag leaves were rolled, the panicle branches tended to be erect and there were many blind florets. The crop did not mature normally forming late tillers which were still green at harvest. The yield of both was reduced to less than 50% of the yield of Sun II, which was the " control " variety, although it has been shown by many trials that under normal conditions the yield of these two varieties is only slightly less than Sun II. The estimated loss in yield through using 2,4-D on these particularly susceptible oat varieties is estimated to be about 17 to 18 cwts. per acre in this instance.

The aim of the work summarised here was to investigate this subject and the problem of testing cereal varieties for susceptibility to spray damage during the period that they are undergoing normal variety trials at the N.I.A.B. In these experiments which were carried out at Cambridge and planned in consultation with the staff of the A.R.C. Unit of Experimental Agronomy at Oxford, the criterion of spray damage was plant deformity and not the possible effect on yield.

These experiments have confirmed that varieties of spring wheats, oats and barleys do differ in their reaction to the growth regulator herbicides. In some instances the differences appear to be quite large which emphasises the importance of testing any new herbicide on a wide range of varieties before it is placed on the market. The factors which cause one variety to be more resistant to damage than another have not been fully investigated except to show that some feature other than growth stage appears to be involved. The possible effects of different formulations have not been explored, nor has sufficient work been carried out on the practical significance to the farmer of such differences as appear to exist between varieties.

**" Outstanding results have been obtained wherever early spraying was done . . . "**

In these Experiments heavy doses were used and in many cases the chemicals were not applied at the commercially recommended growth stage. It is assumed that the varietal differences in response which were demonstrated would have been far smaller, or even absent, if the manufacturers' recommendations had been followed.

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## SOME ASPECTS OF THE USE OF 2,3,6 TBA/MCPA MIXTURES FOR SELECTIVE WEED CONTROL IN CEREALS.

*by* R. K. Pfeiffer, *Chesterford Park Research Station* (*Fisons Pest Control Ltd.*).

1. The paper presented the results from 42 yield experiments carried out during the last 3 years with a mixture of MCPA and 4 ozs. 2,3,6 trichlorbenzoic acid.* This new combination of growth regulating substances (called TBA/MCPA in the paper) was in most cases compared with other selective cereal weedkillers.

2. All cereal crops with the exception of spring wheat had proved unaffected if sprayed between tillering and the beginning of the jointing stage. The safe period on spring wheat appeared to be shorter and more work was required to clarify this point.

3. Some aspects of weed control with TBA/MCPA were briefly discussed and factors affecting the performance of TBA/MCPA listed.

4. Four reasons in favour of early spraying of TBA/MCPA were presented and discussed. These reasons were:—

   (a) Maximum crop safety at earlier development stages.
   (b) Most reliable weed control at early spraying.
   (c) No effect of cold weather on the action of TBA/MCPA.
   (d) Early weed control is likely to give maximum yield increase.

In an attempt to find an answer to the increasing problem of MCPA and 2,4-D resistant weeds in cereals, a specific activity of 2,3,6 TBA and some closely related compounds on many " hormone resistant " species was discovered at Chesterford Park. Further work lead to the development of a new weedkiller (research code number CP 1815) based on a mixture of polychlorbenzoic acids (predominantly 2,3,6 TBA) with MCPA (this new herbicide combination is referred to as TBA/MCPA here).

A considerable amount of experimental work has since been carried out on this mixture in European and some tropical countries, as well as in Australia, Canada and Japan.

* It is at present not practicable to use pure 2,3,6 TBA on a commercial scale. Other chlorbenzoic acids are active although some only slightly and none as active as 2,3,6 TBA. Exact allowance for these can only be made on the basis of extensive biological tests. Most of the work described was carried out with a standard product as sold under the proprietary name Fisons 18-15.

### Factors affecting Weed Control

About 200 field trials over 3 years supported by laboratory investigations during the winter have enabled us to throw some light on the weed response and factors influencing the performance of TBA/MCPA. Large scale field experience in 1958 and trials carried out over 2 years in a number of European and other countries contribute to the significance of the general conclusions presented in a summarised form below. Lack of space does not allow a more detailed discussion.

1. Experience to date confirms that the following of the more important " hormone resistant " weeds are susceptible to TBA/MCPA: Cleavers, (*Galium aparine*) Mayweed (*Matricaria* and *Anthemis* species), Redshank, (*Polygonum persicaria*) Chickweed (*Stellaria media*). Coltsfoot (*Tussilago farfara*), originally thought to be controlled proved rather resistant in field practice. Bugloss (*Echium vulgare*) on the other hand, proved highly susceptible, contrary to expectations. Different Mayweed species appear to react somewhat differently but further work is required to clarify this point.

2. In order to get reliable and complete control, weeds susceptible to TBA must be fully exposed to the spray. The recommended dosage of 4 ozs. TBA per acre is rather critical and cannot be regarded as a substantial overdose such as for instance the normal MCPA dosage recommended for charlock control. The flag of the crop covering the weeds can prevent sufficient penetration of the spray to the weeds. Many of the " hormone resistant " weeds, such as Mayweeds, Chickweed and Cleavers, are often well hidden under the crop in contrast to weeds such as Charlock (*Sinapis arvensis*) and Hempnettle (*Galeopsis tetrahit*) which grow up with it.

3. All results up to date clearly indicate the importance of early spraying with TBA/MCPA.

   Outstanding results have been obtained wherever early spraying was done even in the most difficult season of 1958. This point cannot be overemphasised.

4. In the extremely wet season of 1958 Mayweeds, Cleavers and Chickweed in some cases outgrew the severe initial effect of TBA/MCPA. This phenomena had never been experienced in 1956 and 1957 when death ultimately followed the initial severe check. Experimental evidence has shown a positive correlation between the growing vigour of weeds and the dosage of TBA required to give lasting control. This is contrary to experience with phenoxy type herbicides which require active growth for maximum effectiveness.

5. Our original discovery that the action of TBA is not affected by cold weather conditions has in the meantime been confirmed by experiments in Scandinavia and Japan as well as by this year's large field experience in the U.K. Information from the same sources independently indicate that TBA/MCPA is less affected by rain following soon after spraying than other growth regulating herbicides.